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BIOGAS EXTRACTION FROM WASTE ORANGE PEEL BY DIGESTION PROCESS

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ABSTRACT

In Biogas extraction from waste orange peel by digestion process the disposal methods define the fresh peels of orange for the citrus processing industry has become a major concern. Orange peels are the major solid by-product and the dried orange peels have content of protein, pectin, cellulose, and hemicellulose, those can be converted into a valuable product like methane gas by anaerobic digestion process.

Our main objective is to thoroughly inspect the prospect of handling and transformation of the waste orange peels into the valuable product like biogas. These huge amounts of orange peels are wastely disposed and disposing of them is also a very big concern for the citrus processing industry. The anaerobic digestion process is an economical process to convert the proteins, pectin, cellulose and hemicellulose which are contained in the waste orange peels into methane gas. By using this technique of extracting methane gas from orange peels by Anaerobic digestion or fermentation process, the demand for the fossil fuel can be reduced in future because it is not possible to ensure that we will have enough fossil fuel to run the engine of the vehicle as well as to produce the electricity through plants at the same time we can maintain the free pollution environment.

KEYWORDS: Hemicelluloses, Orange Peels & Biogas

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Original Article

INTRODUCTION

Here our main work is to properly use the peels of orange meant for the actual manufacture of the biogas through the absorption process. Here the anaerobic digestion process can be used to recover the protein, pectin, cellulose, and hemicellulose of the waste orange peels to produce the biogas. After producing the biogas from the waste orange peels by anaerobic digestion process remaining residues can be used us the fertilizer in the field of agriculture.

The extracted methane gas can be used in the power plants to generate electric power. Since Compressed Natural Gas contains about 70 to 90% of methane gas, it can also be used in the field of an automobile to run the engine the vehicles.

Properties of Biogas

The biogas has the following properties,

1. Lighter than the air 2. Highly combustible 3. Clean burning Efficient Abundant Odorless and invisible Non-corrosive Explosive under pressure

Composition of Biogas

Table 1: Composition of Biogas

Component	Formula	Concentration (% by volume)
Methane	CH_4	60 – 85
Carbon dioxide	CO_2	15 – 40
Nitrogen	N_2	0 – 5
Oxygen	O_2	Less than 1
Hydrocarbons	C_2H_{2n+2}	Less than 1
Water vapour	H_2O	1 – 5

BIOGAS USES

Generation of Power

In power generation in the course of gas turbines.

Domestic Purpose

Here mostly the biogas is supplied to homes than on generally used for cooking point.

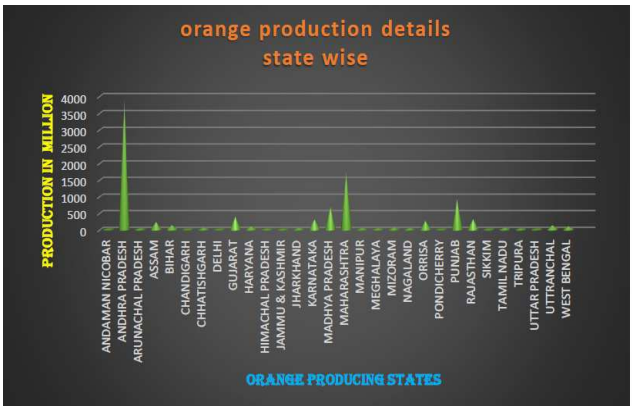

Figure 1: Production of Orange in India

METHODOLOGY

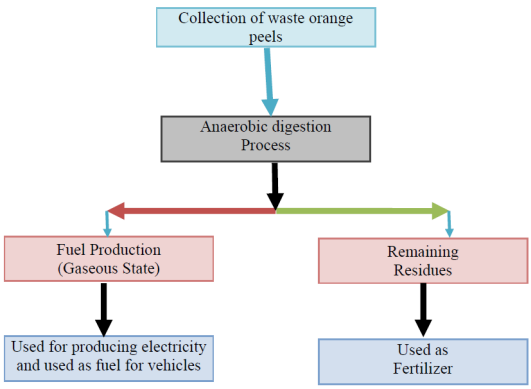

Figure 2: Block Diagram for Extracting Methane Gas from Orange Peels

Equipments and Materials Used

Equipments

The following equipment was used in this project in order to extract the methane gas from the dried orange peel by the anaerobic digestion process.

- Incubator
- Digital pH meter.
- 3. 200ml glass digester with a plastic cork.
- Digital weighing machine.
- Beaker with scale dimension.

Incubator

An incubator is electronic equipment, which is mainly used for maintaining the chemically treated samples of waste orange peel at a favorable temperature (i.e. around 55oC). The incubator, which is used in this project, is equipped with a temperature control unit in which the required temperature can be set and it is capable of maintaining the required things up to 110^0C temperature.

Figure 3: Incubator

This incubator is also having a temperature measuring sensor into it. Here the temperature sensor is mainly used to measure the temperature inside the incubator, so that the switch ON, OFF function of the heater in the incubator is done. It means that once the set temperature is reached inside the incubator then it will automatically switch OFF the heater and vice versa.

Specification of Incubator

Power Supply = 220 Voltage,

Single Phase: 50 HZ,

Alternate current: supply.

Temperature range: 30oC to 110oC.

Accuracy: ± 1oC.

Purpose: Designed to destroy bacteria, virus, and fungus which present in slurries.

Materials

The following materials are used in this project for bio-based extraction from waste orange peels.

- Waste orange peels as a bio-resource for the biogas production.
- Hexane to reduce the d-limonene concentration present in the waste orange peels.
- Lime water (CaOH2) for the chemical treatment of orange peels. Lime is mainly added to carrying out the reactions faster.
- Enzymes for increasing the digestibility of the orange peels.
- Phosphate buffer (NaOH or CO2) to adjust the pH of the pretreated samples of the orange peels.

some solvent often remains inside the solid after completion of the extraction process.

STEPS INVOLVED IN THE PROCESS OF EXTRACTING METHANE GAS FROM PEELS

Collection and Preparation of Orange Peels

The waste peels from the orange were collected to the required quantity. In this project, I used only 300 grams of waste orange peels to extract the methane gas from them by anaerobic digestion process. After collecting the waste orange peel, they are completely washed with the help of luck warm water (water with its temperature around 38oC is known as luck warm water.). Then were dried, it can be done either by drying oven or usually sun-light during day time.

Chemical Treatments of Orange Peel

The orange peels were chemically treated under one condition

- Dried orange peels with various lime concentrations.

Totally ten numbers of samples in dried orange peels were prepared which are listed in the table below.

Table 2: Dried orange peels with various Concentrations of Lime and Water

S.NO.	Quantity of orange peels (in gms)	Concentration of lime (in ml)	Quantity of water (in ml)
1	30	10	40
2	30	9	41
3	30	8	42
4	30	7	43
5	30	6	44
6	30	5	45
7	30	4	46
8	30	3	47
9	30	2	48
10	30	1	49

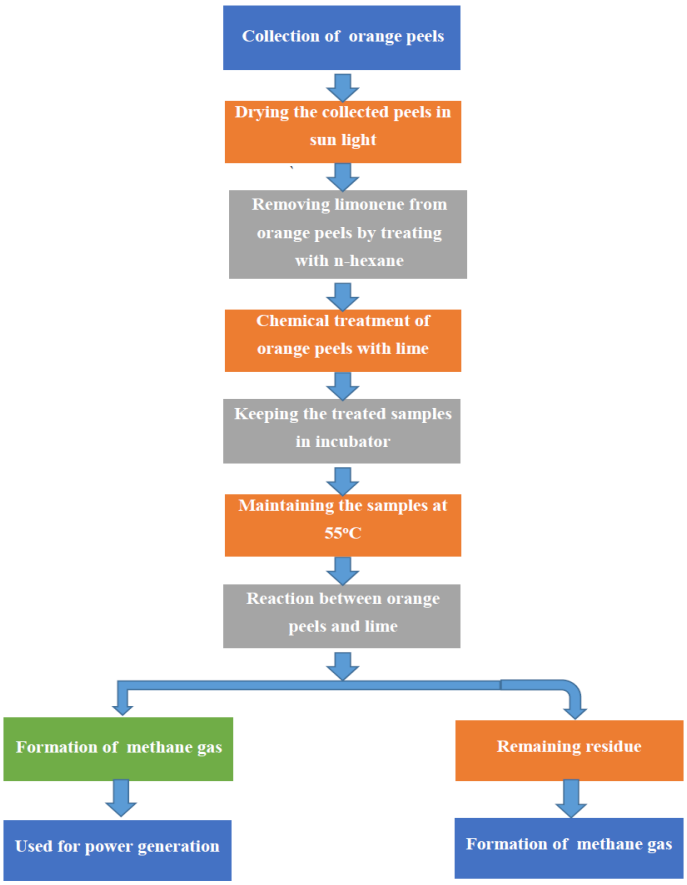

Figure 4: Flow chart

MEASUREMENT TECHNIQUE

The measurement of formed gas inside the each bottle is carried out based on the principle that, in a closed container with water and having two small holes one is at the bottom of the container and another one is at the top of the container and if the hole at the top of the container is exposed to the atmosphere, then the air will enter inside the container and the water will come out at the bottom of the container. If the hole at the top of the container is closed, then the water coming from the container at the bottom is blocked. In this project, the same foresaid technique is used to measure how much amount of gas has been formed inside each bottle.

Figure 5: Picture of Measurement Technique

A small tube with a flow control valve from the gas containing bottle is connected to the hole at the top of the container. When the valve is opened, then the water will come out from the container until the gas goes inside the container at the. Finally, the volume of water collected in the beaker is calculated then by using the relation 1m3 = 1000lit, the total amount of gas formed (in term of ml) inside the bottle is calculated.

For easy understanding,

Height of water collected in the beaker for the sample of 30gms peels with (h) = 4.5 cm = 0.045m

8ml lime, 42ml water

Diameter of the beaker (d) = 3.5cm = 0.035m

Volume of water collected (v) = π/4*d2*h. = π/4*0.0352*0.045.

= 0.00017325 m2.

(i.e.1 m3 = 1000 lit).

= 0.17325 lit.

= 173.25 ml.

Therefore the total amount of gas formed

For the sample, 30 grams peels under the condition of 8ml lime and 42 ml water= 173.25 ml.

Result of Samples of the Dried Peels with a Varying Lime Concentration

Followings are the results which were obtained for the pre-treated samples of dried peels during 10 days of incubation of samples. When the dried peels treated with varying lime concentration, then the obtained methane yield has been shown in table 3 below. Particularly the pre-treated sample of dried peels under the condition of 16% of lime and 84% of the water has given maximum methane yield of 173.25 ml. When increasing the lime concentration above 16%, then the maximum methane yield will be reduced. For instant when increasing the lime concentration from 16% to 18% in the pre-treated samples of the fully dried orange peels, then the methane has been reduced to 92.316 ml and vice versa. Therefore the recommended lime and water concentration to get maximum methane yield is 16% of lime and 84% of water. The graph 5 below indicates the variation of methane yield when the various lime concentration is added to the pre-treated samples of the dried orange peels.

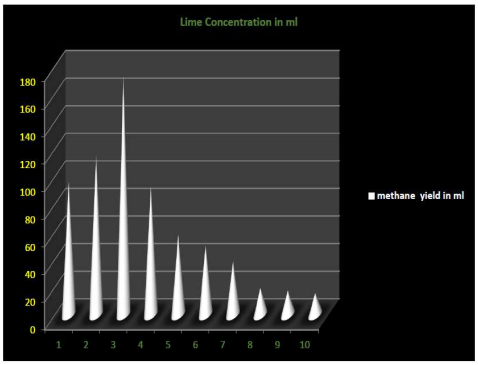

Figure 6: Pictorial Result of Samples of the Dried Orange Peels

Table 3: Result of Samples of the Dried Orange Peels

S.No	Amount of peels (in gms)	Quantity of water (in ml)	Lime concentration (in ml)	Height of water collected in the beaker (in m)	Volume of water collected (in m^3)	Total amount of gas (in ml)
1	30	40	10	0.025	9.61625E-05	96.1625
2	30	41	9	0.03	0.000115395	115.395
3	30	42	8	0.045	0.000173093	173.093
4	30	43	7	0.024	0.000092316	92.316
5	30	44	6	0.015	5.76975E-05	57.6975
6	30	45	5	0.013	5.00045E-05	50.0045
7	30	46	4	0.01	0.000038465	38.465
8	30	47	3	0.005	1.92325E-05	19.2325
9	30	48	2	0.0045	1.73093E-05	17.3093
10	30	49	1	0.004	0.000015386	15.386

ANAEROBIC DIGESTION PROCESS APPLICATIONS

Reducing Methane Emission from Landfills

During employing Anaerobic Digestion Process is to recover the proteins of the dried orange peels such that the emission of pollutants like methane which affect the ocean layer is completely reduced.

CONCLUSIONS

The positive effect on enhancement of methane yield from the waste dried orange peels were obtained by anaerobic digestion process during 10 days of incubation of pre-treated samples of dried orange peels. Particularly the pre-treated sample of dried orange peels under the condition of 16% of lime and 84% of the water has given maximum methane yield of 173.25 ml. when increasing the lime concentration above 16%, then the maximum methane yield will be reduced. For instant when increasing the lime concentration from 16% to 18% in the pre-treated samples of dried orange peels, then the methane has been reduced to 92.316 ml and vice versa.

Finally, I conclude to say is since every day we are consuming a huge amount of Orange as the animal feed and waste peels from them are disposed in the places like open land, lake, revere etc., they are polluting the environment and also cause some diseases to living animals. Instead of disposing of them as the waste, by using this feasible technology we can produce the bio-gas as well as we can maintain a free pollution environment. Because in the future it is not possible to say that there will be enough fuel to run the engines of the vehicles as well as to produce electricity. I hope that definitely, my project will be a source to produce bio-gas in the forthcoming years.

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